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Single-case Models of Case Series Data in Aphasia

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The data from both single-case and case-series studies can be arranged in a matrix of N subjects by M tests. In the prototypical case study, we have a single subject who is given many neuropsychological tests, thus providing a thorough examination of the subject's abilities. The data form a 1 by (large)M matrix, and hence we can call this a "long thin horizontal" study. Since in practice all single-case studies include data from unimpaired controls, the prototype is better described as a 2 by (large)M, matrix with control means forming an additional row. The typical case series, in contrast, is a "long thin vertical" study, with a (large)N by (small)M matrix—many participants, but not a lot of tests. A case series with a single dependent variable is not terribly interesting (e.g. a collection of patient scores on a single verbal STM test), and so the viable minimum would be (large)N by 2, just enough to examine the covariation between the tests. Of course, one can have studies that are not so thin, by testing several subjects on several tests. In this respect, the distinction between case studies with small numbers of subjects but several tests, and case series with many subjects and fewer tests is in fact a continuum.

There is much to be gained by applying computational models to these kinds of studies. Models seek to explain the variation in the matrix, and to make predictions about unexamined cells. There are several ways to incrementally build these models, but the standard method would be to make what we would call "vertical models" by using regression techniques to identify quantitative trends in the covariation between two or three of the tests. Prediction would then also be vertical, that is, the predictions would concern whether other new patients fit the trends. In contrast, we have built models of case-series data by making separate models of each case (e.g. Schwartz et al., 2006). That is, we model the data matrix by creating a series of entirely horizontal models. This strategy is desirable because we start with a model of normal performance, specifically error patterns in a production task such as picture naming that characterize the average control subject. Models of control data are necessarily horizontally thin, as they explain multiple phenomena by the ideal control subject. Then the same data are collected on several patients, turning the data set into a case series. Each row (patient) is then modeled separately by making parametric changes to the normal model. With this kind of strategy, prediction is also carried out horizontally; one predicts how particular patients will perform on new tests. For the symposium, I will illustrate the vertical and horizontal approaches to modeling case series data, with an emphasis on the advantages of the horizontal approach and how both can be combined.

References

Schwartz, M. F., Dell, G. S., Martin, N., Gahl, S., & Sobel, P. (2006). A case-series test of the interactive two-step model of lexical access: Evidence from picture naming. *Journal of Memory and Language, 54* , 228-264.

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